White Nail

Radio Transmitter: Billion Dollar Savings Through Energy Efficiency

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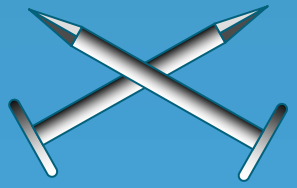
Environment, Energy Security & Sustainability Symposium & Exhibition



NAVSEA WARFARE CENTERS

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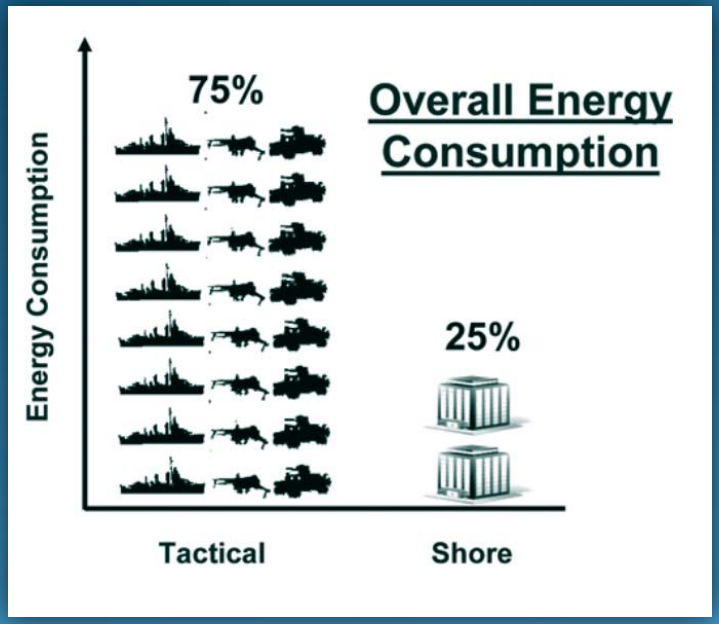
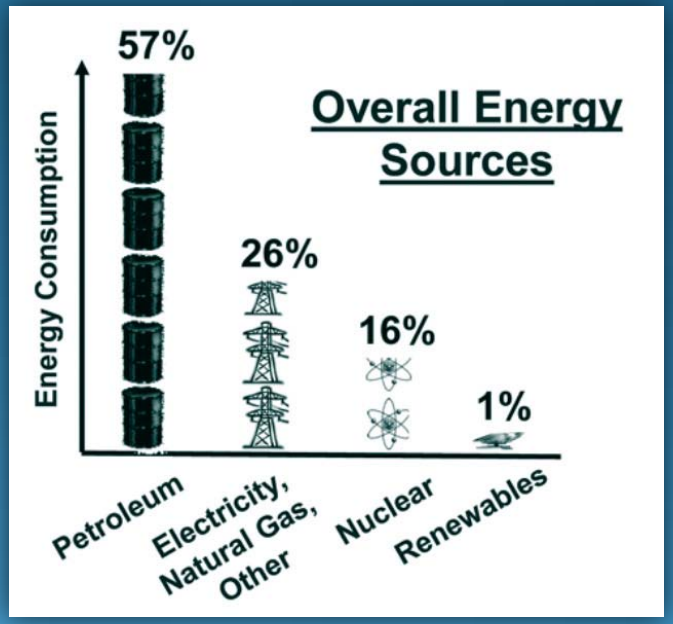
Today: Naval Energy Use





Source: RADM Philip H. Cullom, Chapter 4.2 Climate and Energy Symposium 2010, Proceedings, hosted by JHU/APL and CNA

"Every day, the Navy consumes ... 20,000 megawatt hours of electricity ashore " Navy energy Vision, P2

= 7.3 Billion kilowatt hours per year

Efficiency and Conservation Ashore: By 2020, the Navy will increase efficiency and reduce overall energy consumption ashore by 50 percent

CNO, Navy Energy Vision, P 10

White Nail Vision

Your Cell Phone

Cell Infrastructure

250,000 Towers in USA

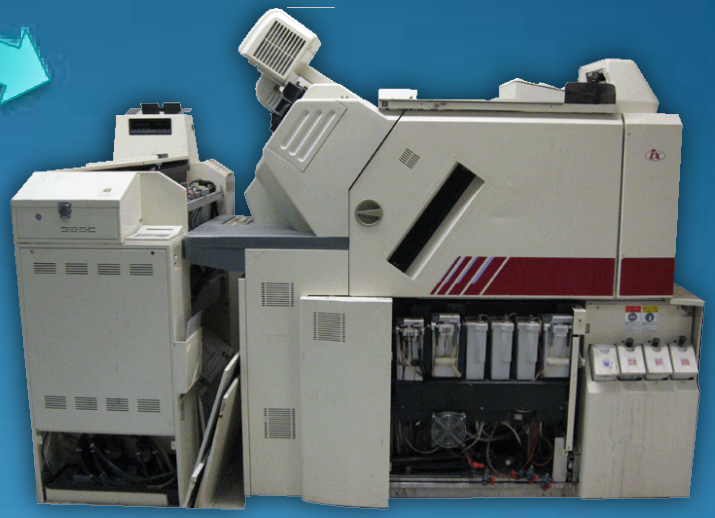
Radio Frequency Power

Grid Power

208V 3 Phase

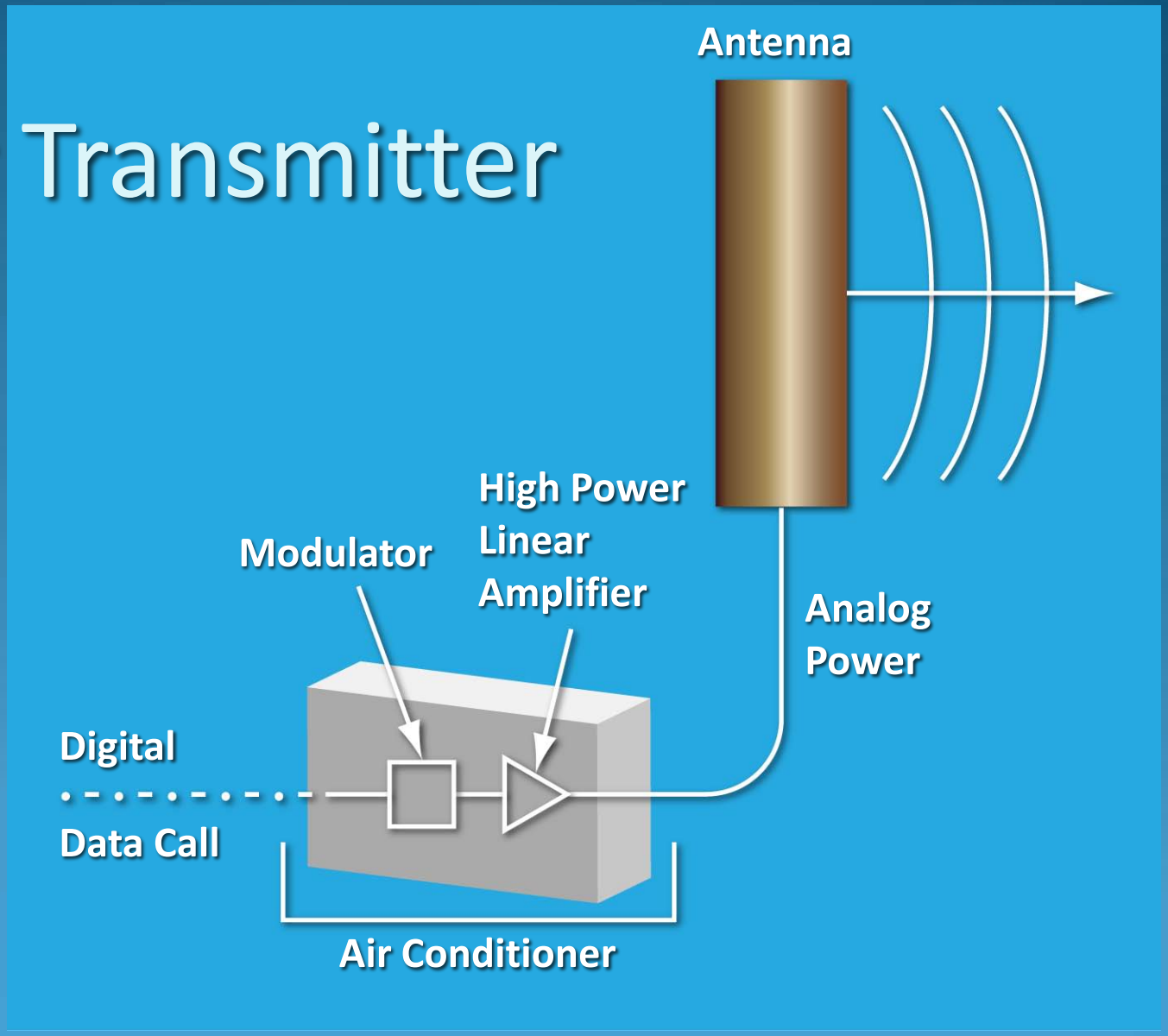
Cooling Power

Film Camera

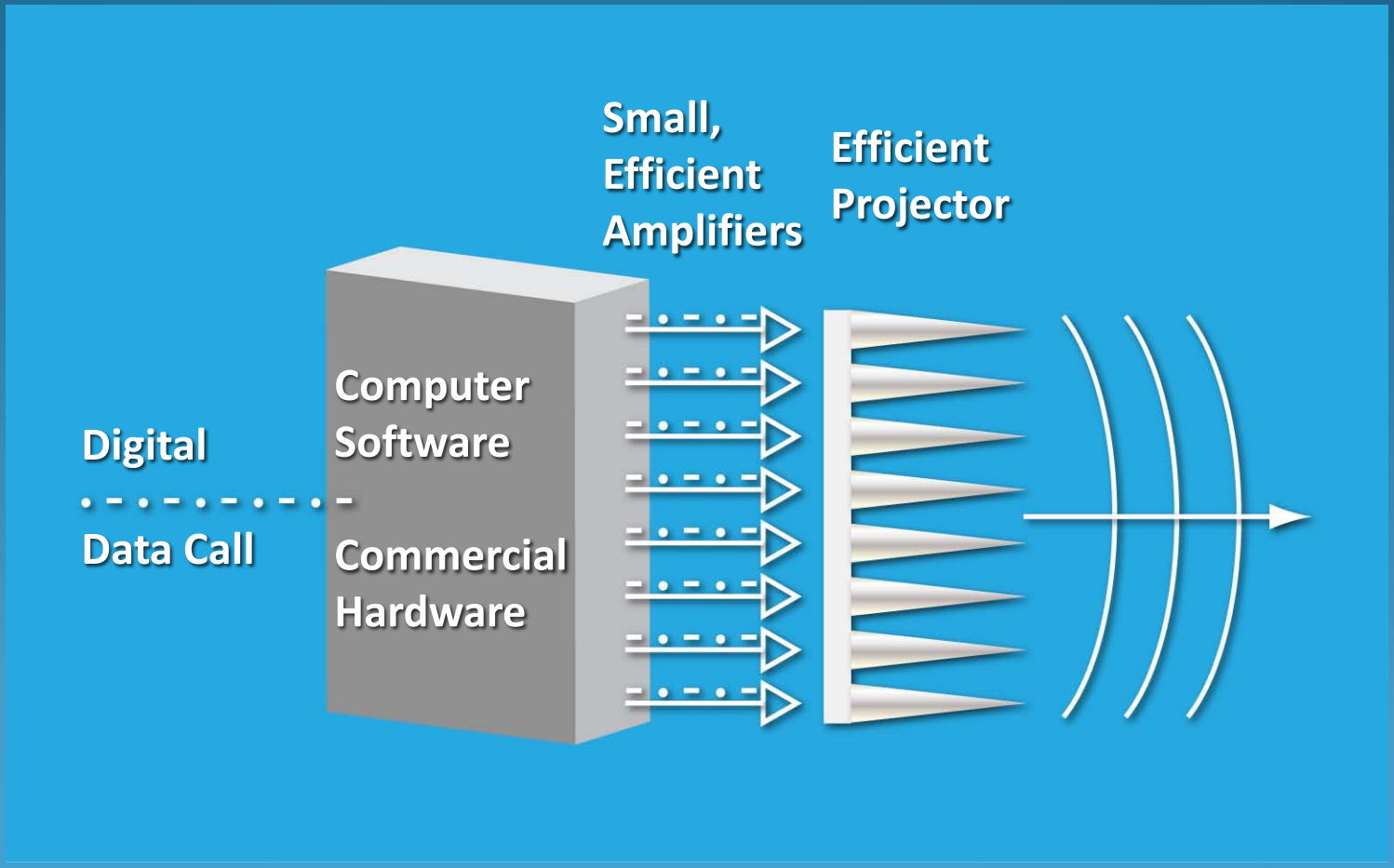


Digital Camera

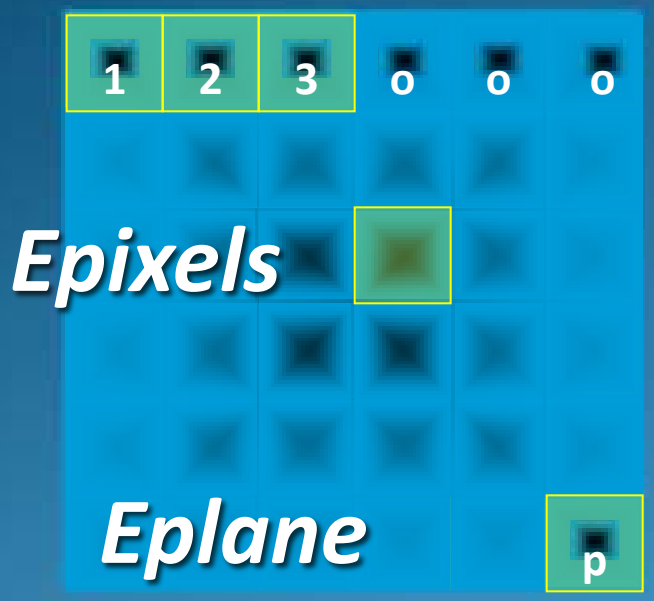
Cellular Transmitter

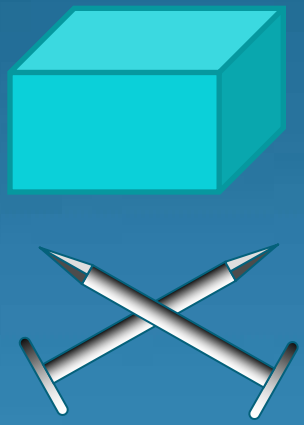


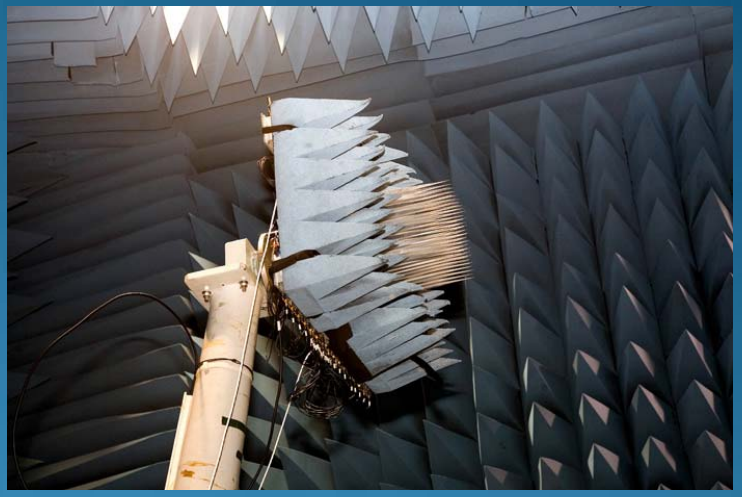
White Nail Transmitter



White Nail



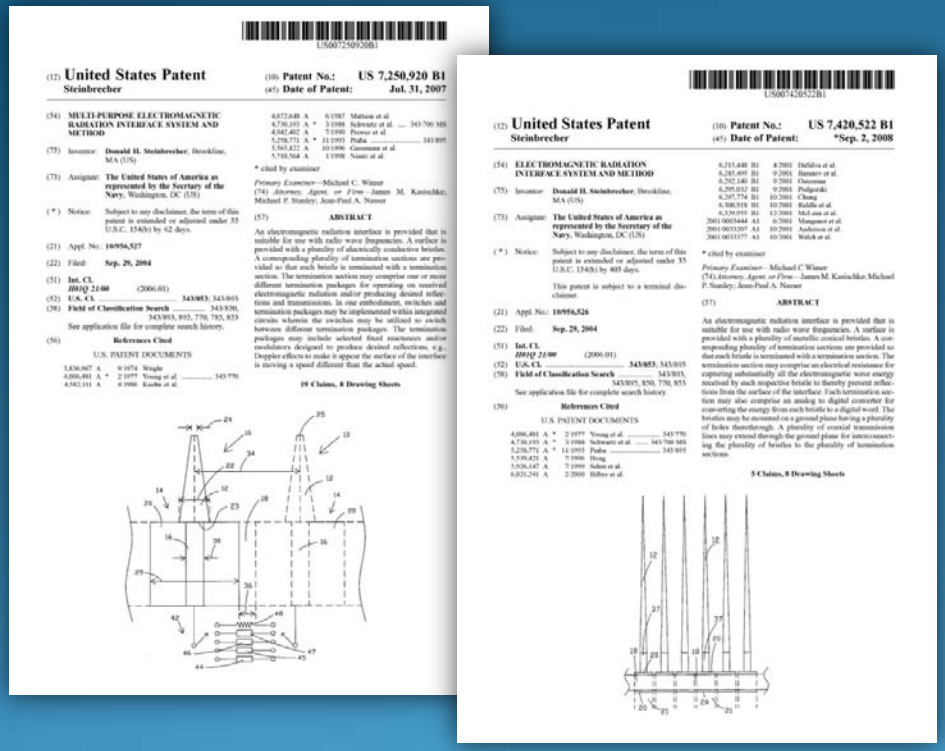




White Nail air interface in chamber for testing

The White Nail Eplane effective aperture is partitioned into *p* equal area Epixels, each of which captures a small 'piece' of the incident RF signals. The pieces are processed individually and reassembled in the digital domain to create a digital image of the incident RF signal set. When transmitting, the Epixel signal pieces are transmitted independently and spatially reassembled to form a beam.

Naval Warfare Center Technology



(12) **United States Patent**
Steinbrecher

(10) **Patent No.: US 7,250,920 B1**
(45) **Date of Patent: Jul. 31, 2007**

(54) **MULTI-PURPOSE ELECTROMAGNETIC RADIATION INTERFACE SYSTEM AND METHOD**

(75) Inventor: **Donald H. Steinbrecher**, Brookline, MA (US)

(73) Assignee: **The United States of America as represented by the Secretary of the Navy**, Washington, DC (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 62 days.

(21) Appl. No.: **10/956,527**

(22) Filed: **Sep. 29, 2004**

(51) **Int. Cl.**
H01Q 21/00 (2006.01)

(52) **U.S. Cl.** **343/853**; 343/815

(58) **Field of Classification Search** 343/830, 343/893, 895, 770, 785, 853

See application file for complete search history.

(56) **References Cited**

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Primary Examiner—Michael C. Wimer
(74) *Attorney, Agent, or Firm*—James M. Kasischke; Michael P. Stanley; Jean-Paul A. Nasser

(57) **ABSTRACT**

An electromagnetic radiation interface is provided that is suitable for use with radio wave frequencies. A surface is provided with a plurality of electrically conductive bristles. A corresponding plurality of termination sections are provided so that each bristle is terminated with a termination section. The termination section may comprise one or more different termination packages for operating on received electromagnetic radiation and/or producing desired reflections and transmissions. In one embodiment, switches and termination packages may be implemented within integrated circuits wherein the switches may be utilized to switch between different termination packages. The termination packages may include selected final reactances and/or oscillators designed to produce desired reflections, e.g., Doppler effects to make it appear the surface of the interface is moving a speed different than the actual speed.

19 Claims, 8 Drawing Sheets

US007420522B1

(12) **United States Patent**
Steinbrecher

(10) **Patent No.: US 7,420,522 B1**
(45) **Date of Patent: *Sep. 2, 2008**

(54) **ELECTROMAGNETIC RADIATION INTERFACE SYSTEM AND METHOD**

(75) Inventor: **Donald H. Steinbrecher**, Brookline, MA (US)

(73) Assignee: **The United States of America as represented by the Secretary of the Navy**, Washington, DC (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 403 days.

This patent is subject to a terminal disclaimer.

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Primary Examiner—Michael C Wimer
(74) *Attorney, Agent, or Firm*—James M. Kasischke; Michael P. Stanley; Jean-Paul A. Nasser

(57) **ABSTRACT**

An electromagnetic radiation interface is provided that is suitable for use with radio wave frequencies. A surface is provided with a plurality of metallic conical bristles. A corresponding plurality of termination sections are provided so that each bristle is terminated with a termination section. The termination section may comprise an electrical resistance for capturing substantially all the electromagnetic wave energy received by each respective bristle to thereby prevent reflections from the surface of the interface. Each termination section may also comprise an analog to digital converter for converting the energy from each bristle to a digital word. The bristles may be mounted on a ground plane having a plurality of holes therethrough. A plurality of coaxial transmission lines may extend through the ground plane for interconnecting the plurality of bristles to the plurality of termination sections.

5 Claims, 8 Drawing Sheets

- 12 Years of Basic Research and Exploratory Development

Dr. Donald H. Steinbrecher
Also 6,460,167; others in process

Leveraging World Class Expertise

Cell Phone Transmitter Efficiency

An Efficiency Performance Comparison				
Parameter	Conventional Transmitter		White Nail Transmitter	
	Units		Units	
Antenna EIRP	Watt	6,014.25	Watt	6,014.25
Antenna Gain	ratio	50.12	ratio	50.12
Transmitted Power	Watt	120.00	Watt	120
Antenna Aperture Efficiency	ratio	0.6	ratio	0.94
RF Output Power	Watt	200.00	Watt	127.66
RF Generation Efficiency	ratio	0.3	ratio	0.51
Supplied Power	Watt	666.67	Watt	250.00
Supplied power saved			Watt	416.67
Estimated Total Number of transmitters		3,000,000		
Estimated total power saved	Watt	1,250,000,000		

1.25 Gigawatts saved

– Power

11 Billion Kilowatt Hours per year saved

– Energy

$1.6 Billion Dollars per year saved

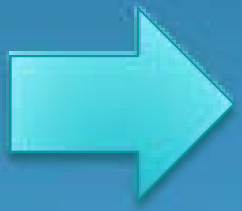
– Cost

10.4 Million metric Tons CO2 per year saved

– Greenhouse Gas

Power

4



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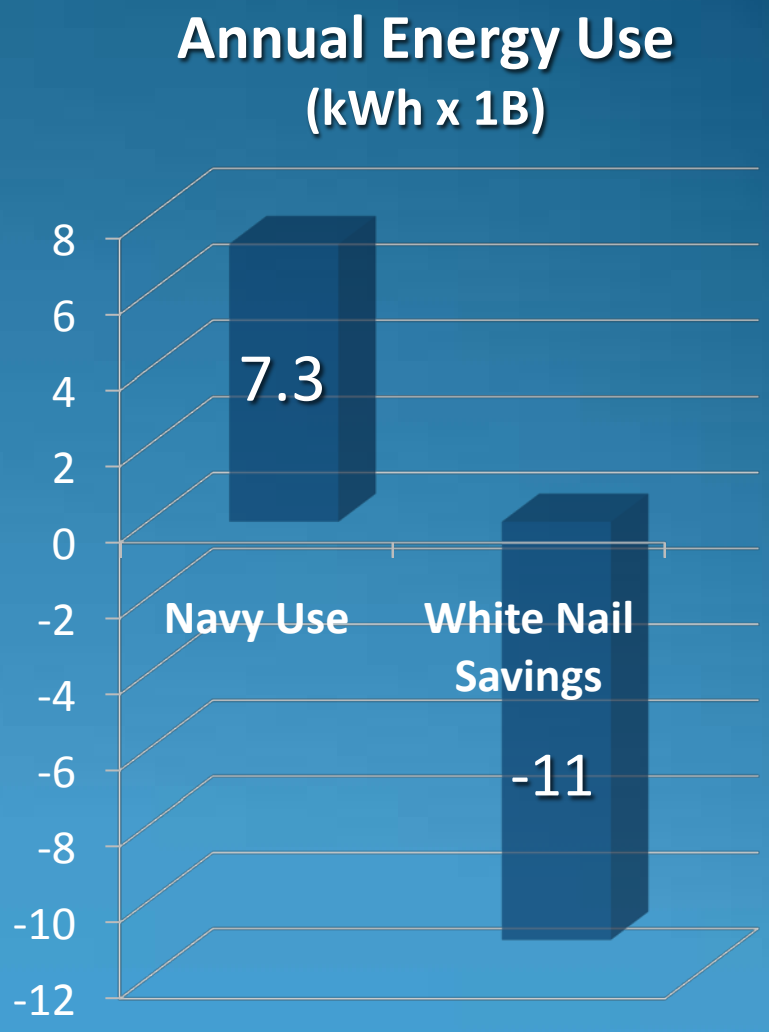
Energy

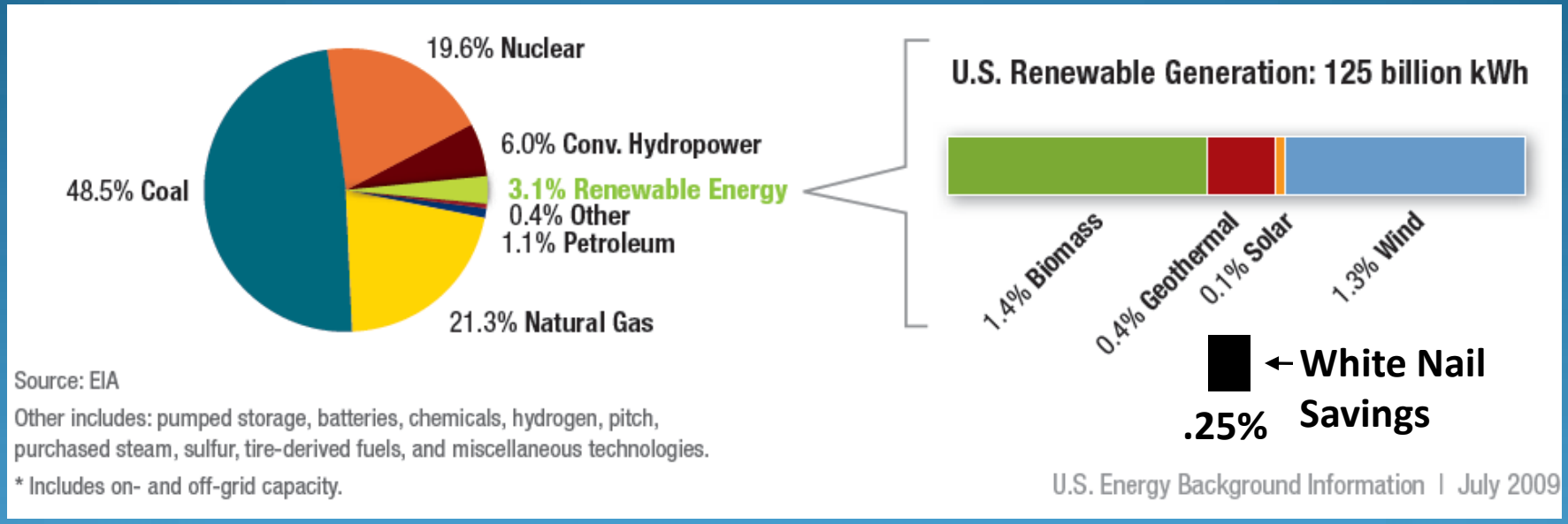
Navy Use
7.3 Billion kWh
White Nail Cell Phone Savings
11 Billion kWh

One and a half times!!!

Saves the output of four of Massachusetts' six coal fired power plants



US electrical energy in 2008
4,112 billion kWh



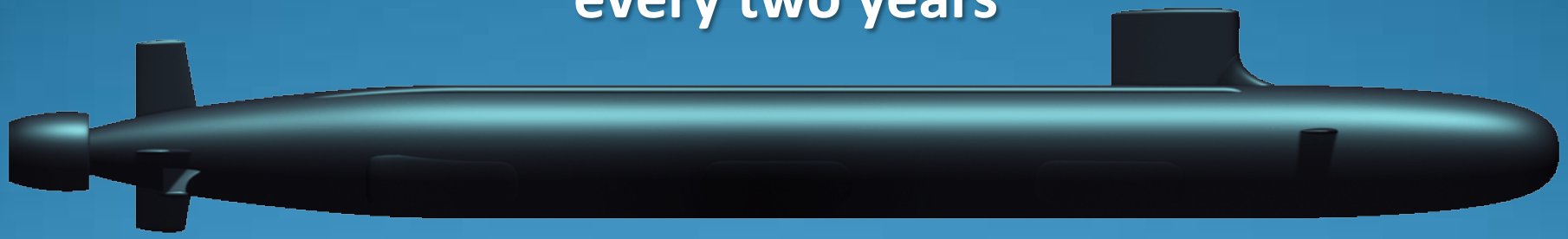
11 Billion kWh = Savings 0.25%

We are on the national map!!

Financial Savings
$1.6 B/yr

Additional Virginia class submarine

every two years



Annual Carbon Reduction

1 + 1/2

10.4 Million Metric Tons CO_2 as Glassy Carbon (C) Volume

Naval Impact Potential

- DoD portion of commercial wireless
- Radar
- Shipboard “Topside Integration”
- Shipboard electrical generation fuel savings
- Satellite – size, weight and power
- Expeditionary unit’s wireless efficiency

Valley of Death

Way ahead Development

- **Technology: System level demonstration**
- **Commercial prototype and demonstration**
- **Commercial industrial production**

Spiral Two

- **DoD/Navy Innovation using commercial components**

Our Request from YOU

- Contacts
  - Commercial wireless industry
  - Infrastructure architects
  - DOE
- DoD/Navy
  - What are the appropriate issues to address
  - National Energy Security vs. Military Energy Security
- Innovator, Technologist: Talk to us
- Resource Sponsor: Opportunities to propose

Navy Technology
+
Commercial Application